

CLAIMS

Claims:

1. A method of making a resilient contact structure, the method comprising
- 3 providing an electronic component with a surface and a terminal near the surface,
- 6 depositing a masking layer on the electronic component with an opening near the terminal,
- 9 depositing a seed layer of conductive material over at least a portion of the terminal to form a base region of the seed layer and over at least a portion of the masking layer to form a main body region of the seed layer, connecting the base region and main body region, and
- 12 depositing on the seed layer a bulk layer of conductive material to form a resilient contact structure electrically connected to the terminal.
2. The method of claim 1 further comprising:
- 3 before depositing the masking layer, depositing an initial conductive layer of conductive material over at least a portion of the electronic component and over at least a portion of the terminal, then depositing the masking layer
- 6 over at least a portion of the initial conductive layer.
3. The method of claim 1 further comprising removing the masking layer to free the resulting resilient contact
- 3 structure.
4. The method of claim 1 further comprising patterning the seed layer to define an outline of a resilient member.

5. The method of claim 1 further comprising patterning the main body region of the seed layer to include an approximately circular region, with an inner curve which is approximately circular with an inner radius which is smaller than an outer curve which is approximately circular with an outer radius, with the center point of the inner radius suitably offset from the center point of the outer radius so that the approximately circular region outlines a resilient member.

6. The method of claim 1 further comprising placing on the masking layer a protruding element before depositing the seed layer, then depositing the seed layer to at least partially cover the protruding element, whereby when the bulk layer of conductive material is deposited on the seed layer, a portion of the bulk layer which is deposited on the seed layer on the protruding element, it forms a conductive region which is farther removed from the electronic component than other portions of the bulk layer.

7. The method of claim 1 wherein the main body region of the seed layer is approximately parallel to and displaced from the surface of the electronic component,

8. The method of claim 7 wherein the main body region is displaced from the surface of the electronic component by a distance of between about 5 and 200 mils (thousandths of an inch).

9. The method of claim 7 wherein the main body region is displaced from the surface of the electronic component by a distance of between about 2 and 8 mils.

10. The method of claim 1 further comprising patterning the seed layer by depositing the seed layer through a shadow mask with one or more openings to define the shape of the desired seed layer.

11. The method of claim 1 further comprising fabricating the opening in the masking layer to include a sloped region between the surface of the electronic component and the surface of the masking layer away from the electronic component.

12. The method of claim 11 further comprising a connecting region of the seed layer that includes at least a portion of the sloped region, connecting between the main body region and the base region.

13. The method of claim 1 wherein the masking material has a thickness of between about 50 and 200 microns.

14. The method of claim 1 wherein the opening in the masking layer includes an area on the surface of the electronic component, which may include some or all of the terminal, with an area of about 10,000 to about 40,000 square microns.

15. The method of claim 1 wherein the opening in the masking layer includes an area on the surface of the electronic component, which may include some or all of the terminal, sufficient to secure the ultimate resilient contact structure.

16. The method of claim 11 where the sloped region has an average angle of between about 60 and about 75 degrees.

17. The method of claim 6 wherein the protruding element protrudes between about 2 and 7 mils from the masking layer.

18. The method of claim 6 wherein the protruding element has a base dimension of between about 5 and about 15 mils.

19. The method of claim 1 wherein the seed layer has a thickness of between about 1000 and 4000 angstroms.

20. The method of claim 1 wherein the seed layer comprises gold with a thickness of about 2500 to about 4000 angstroms.

21. The method of claim 1 wherein the seed layer comprises copper with a thickness of about 1000 to about 3000 angstroms.

22. The method of claim 2 wherein the initial conductive layer has a thickness of between about 3000 and about 6000 angstroms.

23. The method of claim 2 wherein the initial conductive layer comprises an alloy of titanium and tungsten.

24. The method of claim 2 further comprising depositing a second conductive layer on the initial conductive layer.

25. The method of claim 24 wherein the second conductive layer is gold, with a thickness of between about 2500 and about 4500 angstroms.

26. The method of claim 1 wherein the masking material comprises a material selected from the group consisting of polyimide, Novolac resin, and a photoresist.

27. The method of claim 1 wherein the opening has sidewalls and the seed layer substantially covers the sidewalls.

28. The method of claim 1 wherein the opening has sidewalls and the seed layer only partially covers the sidewalls.

29. The method of claim 1 wherein the seed layer is deposited by a process selected from the group consisting of sputtering, chemical vapor deposition, physical deposition, and e-beam deposition.

30. The method of claim 1 wherein the bulk layer of conductive material is deposited by electrolytic plating.

31. The method of claim 1 wherein the bulk layer of conductive material is deposited by a process selected from the group consisting of electrolytic plating, electroless plating, chemical vapor deposition, physical vapor deposition, a process involving the deposition of material out of an aqueous solution, and a process causing the deposition of material through induced disintegration of a precursor, liquid or solid.

32. The method of claim 1 wherein the bulk layer of conductive material comprises nickel.

33. The method of claim 1 wherein the bulk layer of conductive material comprises a material selected from the group consisting of nickel, copper, cobalt, iron, gold, silver, elements of the platinum group, noble metals, semi-noble metals, elements of the palladium group, tungsten, and molybdenum.

34. The method of claim 1 further comprising forming a conductive component between the terminal of the electronic component and a remote terminal on the surface of the electronic component, disposed away from the terminal, then depositing the masking layer with the opening over the remote terminal rather than the original terminal, and further

depositing the seed layer and the bulk layer to contact the remote terminal according to the opening in the masking layer.

35. The method of claim 1 further comprising fabricating a separate tip structure and joining it permanently to the resilient contact structure to make a second, modified resilient contact structure.

36. The method of claim 35 further comprising fabricating a post structure connected to the separate tip structure and joining the post structure to the resilient contact structure to make a third, modified resilient contact structure.

37. The method of claim 1 wherein the electronic component is a semiconductor device.

38. The method of claim 1 wherein the electronic component is a semiconductor device which has not been singulated from a wafer.

39. The method of claim 1 wherein the electronic component is selected from the group consisting of a semiconductor device, a memory device, a portion of a semiconductor wafer, a space transformer, a ceramic device, a probe card, a chip carrier and a socket.

40. A resilient contact structure of conductive material, comprising

a base region connected to an electronic component, the electronic component having a surface and a terminal near the surface,

a main body region, displaced away from the surface, and connected to the base region,

each of the base and main body regions comprising the  
9 conductive material,

whereby the resilient contact structure is secured to the  
electronic component and electrically connected to the  
12 terminal.

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B' / 41. The resilient contact structure of claim 40 further  
comprising the main body region comprising an approximately  
3 circular region, with an inner curve which is approximately  
circular with an inner radius which is smaller than an outer  
curve which is approximately circular with an outer radius,  
6 with the center point of the inner radius suitably offset from  
the center point of the outer radius so that the approximately  
circular region outlines a resilient member.

42. The resilient contact structure of claim 40 further  
comprising a tip region, connected to the main body region and  
protruding away from the main body region and away from the  
surface of the electronic component, electrically connected to  
the terminal.

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B' / 43. The resilient contact structure of claim 40 wherein the  
main body region is approximately parallel to and displaced  
from the surface of the electronic component.

44. The resilient contact structure of claim 43 wherein at  
least a portion of the main body region is displaced from the  
3 surface of the electronic component by a distance of between  
about 5 and 200 mils (thousandths of an inch).

45. The resilient contact structure of claim 43 wherein at  
least a portion of the main body region is displaced from the  
3 surface of the electronic component by a distance of between  
about 2 and 8 mils.

Sub B2/ 46. The resilient contact structure of claim 40 further comprising a sloped region within the connected base region and main body region .

47. The resilient contact structure of claim 40 wherein the base region is connected to the surface of the electronic component, which may include some or all of the terminal, with an area of about 10,000 to about 40,000 square microns.

48. The resilient contact structure of claim 40 wherein the base region is connected to the surface of the electronic component, which may include some or all of the terminal, with an area sufficient to secure the resilient contact structure.

Sub B2/ 49. The resilient contact structure of claim 46 where the sloped region has an average angle of between about 60 and about 75 degrees.

50. The resilient contact structure of claim 42 wherein the tip region protrudes between about 2 and 7 mils from the main body region away from the surface of the electronic component.

51. The resilient contact structure of claim 42 wherein the tip region has a base width of between about 5 and about 15 mils, measured generally parallel to the surface of the electronic component.

52. The resilient contact structure of claim 40 wherein the base has sidewalls that substantially form a funnel-type structure.

53. The resilient contact structure of claim 40 wherein the base has sidewalls that substantially form a partial funnel-type structure.



Sub B4/ 54. The resilient contact structure of claim 40 wherein the conductive material comprises nickel.

55. The resilient contact structure of claim 40 wherein the conductive material comprises a material selected from the group consisting of nickel, copper, cobalt, iron, gold, silver, elements of the platinum group, noble metals, semi-noble metals, elements of the palladium group, tungsten, and molybdenum

56. The resilient contact structure of claim 40 further comprising

a remote terminal near the surface of the electronic component, and

a conductive component connecting the remote terminal to the terminal of the electronic component,

wherein the base region is secured to and connected to at least a portion of the remote terminal, and electrically connected to the terminal of the electronic component.

57. The resilient contact structure of claim 40 wherein the electronic component is a semiconductor device.

58. The resilient contact structure of claim 40 wherein the electronic component is a semiconductor device that has been singulated from a wafer.

59. The resilient contact structure of claim 40 wherein the electronic component is selected from the group consisting of a semiconductor device, a memory device, a portion of a semiconductor wafer, a space transformer, a ceramic device, a probe card, a chip carrier and a socket.

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60. The resilient contact structure of claim 40 further comprising a separate tip structure joined permanently to the resilient contact structure to make a second, modified resilient contact structure.

61. The resilient contact structure of claim 60 further comprising a post structure connected to the separate tip structure and joined to the resilient contact structure to make a third, modified resilient contact structure.

62. A method of using the resilient contact structure of claim 40 by providing a second electronic component with a second terminal thereon and contacting the resilient contact structure to the second terminal.

63. The method of claim 62 further comprising effecting a pressure connection between the resilient contact structure and the second terminal so as to effect an electrical connection between the first and the second terminals.

64. The method of claim 62 further comprising effecting a permanent connection between the resilient contact structure and the second terminal so as to effect an electrical connection between the first and the second terminals.